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Magnetic Field evolution in Laser Plasma interaction

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The understanding of the generation and evolution of magnetic field has aroused research interest in several contexts. Laboratory and Particle -In – Cell simulation studies in the context of Laser plasma have proved helpful in providing an opportunity to investigate and understand various aspects of generation and evolution characteristics of magnetic field. An overview of such studies will be presented in this talk. In underdense plasma, there is evidence of magnification of magnetic fields by intense laser pulses [1]. In the overdense plasma medium this occurs indirectly by energetic electrons which get generated by the laser at the critical density surface. Conventionally, it is believed that the plasma provides for the return shielding current to balance the forward current generated by the energetic electrons. The spatial separation of these two currents due to a variety of instabilities (Weibel, filamentation, Kelvin Helmholtz) etc., subsequently lead to the generation of magnetic field. The sequence of instabilities that occur is important in defining the characteristics spectrum of the magnetic field. Recently, it has been shown by us that electron beam in a plasma is unstable to negative energy modes driven by radiative damping. A novel mechanism of magnetic field generation has been proposed which rely on the emission of radiation from the beam and plasma boundaries. The characteristics features of the magnetic field spectra observed in experiments provide direct support for this mechanism to be operative [2].

References :

[1] Wilson, et al. "Magnetic field amplification by high power lasers in underdense plasmas " *Plasma Physics and Controlled Fusion* **61** (2021): 084001.

[2] Das, Amita et al. "Boundary driven unconventional mechanism of macroscopic magnetic field generation in beam-plasma interaction", *Physical Review Research,* **2** (2020): 033405.